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HOWARD UNIVERSITY

DEPARTMENT OF CHEMISTRY

WASHINGTON, D. C.

SIXTH QUARTERLY REPORT

1 July to 30 September 1965

WAVE SPECTRA AND DIELECTRIC PROPERTIES OF VARIOUS AZIDES

Contract DA-44-009-AMC-536T

U. S. Army Engineer Research and Development Laboratories

Fort Belvoir, Virginia

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Dielectric Studies of Silver Azide

in the 50-60 KMcs Region

I. Introduction

Previously dielectric data were submitted on α-and β-lead, potassium and thallium azides, and on polystyrene in the 50-60 KMcs region. The dispersion curves for each of the crystalline systems are different. All show an anomaly around 55 KMcs with the exception of polystyrene which was used as a control. The curves of potassium and thallium azides are very similar, and since both of these azides crystallize in the same crystalline system (body centered tetragonal), it was decided to study another azide in the same system as α-lead azide.

II. Experimental

The silver azide crystals were grown i
laboratory and were prepared as follows:

From a solution of potassium azide, the silver was precipitated by addition of silver nitrate. The precipitate was washed free of potassium, silver and nitrate ions. It was then dissolved in ammonium hydroxide and the crystals were grown from this solution in the usual manner.

The method used in obtaining the dielectric data was the same as that described in previous reports. Two silver azide crystals were studied. In addition, data were taken on one of these with the cavity in the magnetic field of a fixed magnet. The magnetic field strength, 1.25 kilogauss, was measured by use of a gauss meter. The position of the cavity was such that the axis of the cylindrical cavity was midway between the pole pieces and normal to the magnetic field. Thus the sample was also normal to the direction of the field.

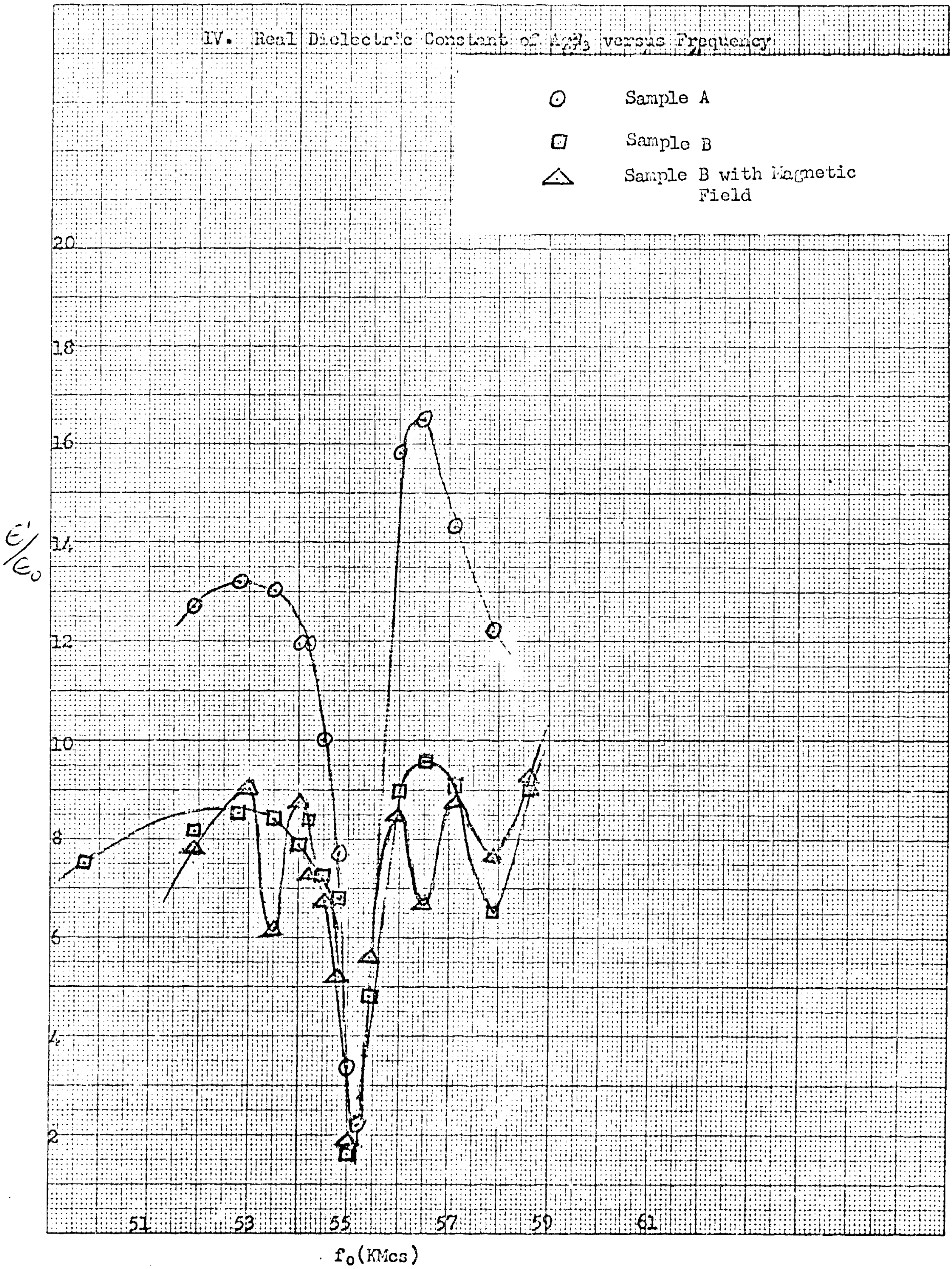
Since a possible explanation of anomaly observed in the dielectric behavior of these azides is a $^3\Sigma$ ground state for the azide ion, we wanted to see the effect of a magnetic field on the degeneracy which would be present in a triplet state.

III. Table of Data

f_0 (KMcs)	G	Δf_0 (Mc) Sample A	Sample B	Sample B	$V_c/V_s \times 10^{-3}$ Sample A	Sample* B	ϵ/ϵ_0 Sample A	Sample B	Sample* B
49.7	0.9466	—	60	—	11.81	5.13	—	7.57	—
51.9	0.8678	50	67	64	11.03	4.79	12.69	8.15	7.80
52.8	0.8386	49	69	75	10.96	4.76	13.16	8.53	9.04
53.5	0.8169	51	73	52	10.27	4.46	13.01	8.45	6.13
54.0	0.8017	47	68	76	10.13	4.40	11.94	7.91	8.76
54.2	0.7958	47	73	62	10.06	4.37	11.96	8.39	7.29
54.5	0.7872	39	62	57	9.92	4.31	10.03	7.25	6.73
54.8	0.7785	29	58	42	9.85	4.28	7.70	6.82	5.19
55.0	0.7729	10	6	32	9.83	4.27	3.36	1.60	1.81
55.2	0.7673	5	12	13	9.72	4.22	2.17	2.18	2.31
55.4	0.7618	—	38	46	9.63	4.20	—	4.79	5.59
56.0	0.7455	65	80	75	9.59	4.17	15.77	8.96	8.46
56.5	0.7325	68	86	67	9.47	4.11	16.53	9.57	6.67
57.1	0.7172	60	83	75	9.16	3.98	14.39	9.04	8.28
57.9	0.6975	56	64	75	8.19	3.56	12.29	6.52	7.62
58.6	0.6808	—	63	95	7.97	3.47	—	8.97	9.26

Weight of Sample A .... 0.1184 mg
Weight of Sample B .... 0.2724 mg
Density of AgN_3* .... 5.015 gm/cm^3

* Run with magnet


IV. Real Dielectric Constant of AgN_3 versus Frequency
Sample A
Sample B
Sample B with Magnetic Field
ϵ'/ϵ_0
20
18
16
14
12
10
8
6
4
2
51
53
55
57
59
61
f_o (KMcs)

V. Discussion

The dispersion curves obtained for silver azide show the same anomalous effect around 55 KMcs that was observed in the curves for all the other azides. A comparison of the nature of the curves for silver azide and that of α-lead azide (Lead azide curve is shown in the Third Quarterly Report, Contract No. DA-44-009-AMC-536(T), 1 October to 31 December 1964.) shows that they are quite different, even though silver and α-lead azides are members of the same crystalline system (orthorhombic). Silver azide yields a curve which is very similar to those of potassium and thallium azides. The latter two are members of the tetragonal system. Thus, orientation of the axis of the azide ion with respect to the unit cell, while different in orthorhombic and tetragonal crystals, does not appear to be an important factor with regard to the curve shape.

Again, if one compares the two curves of sample B, one with and the other without magnetic field, one observes two more minima in the curve obtained with a magnetic field than is shown by the curve obtained for silver azide without a magnetic field. These minima are at 53.5 KMcs and 56.5 KMcs and are thus ± 1.5 KMcs removed from 55.0 KMcs, the minimum obtained for all samples without a magnetic field. A determination of whether or not these new minima represent some splitting can best be made after measurements in the 53-54 KMcs and 56-57 KMcs intervals are taken at every 0.1 KMcs. Measuremonts at such close intervals present some tuning problems and with rare exceptions we have not been able to do better than 0.2 KMcs.

Finally, susceptability studies on some of these azides do not rule out the possibility of a ferromagnetic impurity. If a ferromagnetic impurity were definitely established as being present in our samples, it would drastically alter the interpretation to be put on these studies.

VI. Present Status

At the present time, further studies are being carried out at different field strengths using an electromagnet. These data will be submitted in the very near future along with an exploratory study of the effect of light on the dielectric constant of silver azide. Preparations are about complete for a temperature dependence study but the problem of getting reproducible data on the imaginary dielectric constant has not been solved.